

## Calendar No. 772

107<sup>TH</sup> CONGRESS  
2<sup>D</sup> SESSION**S. 2945****[Report No. 107-350]**

To authorize appropriations for nanoscience, nanoengineering, and nanotechnology research, and for other purposes.

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## IN THE SENATE OF THE UNITED STATES

SEPTEMBER 17, 2002

Mr. WYDEN (for himself, Mr. LIEBERMAN, Mr. ALLEN, Ms. LANDRIEU, Mrs. CLINTON, Ms. MIKULSKI, Mr. WARNER, and Mr. LEVIN) introduced the following bill; which was read twice and referred to the Committee on Commerce, Science, and Transportation

NOVEMBER 20, 2002

Reported by Mr. HOLLINGS, without amendment

**A BILL**

To authorize appropriations for nanoscience, nanoengineering, and nanotechnology research, and for other purposes.

1 *Be it enacted by the Senate and House of Representa-*  
2 *tives of the United States of America in Congress assembled,*

3 **SECTION 1. SHORT TITLE.**

4 This Act may be cited as the “21st Century  
5 Nanotechnology Research and Development Act”.

1 **SEC. 2. FINDINGS.**

2 The Congress makes the following findings:

3 (1) The emerging fields of nanoscience and  
4 nanoengineering (collectively, “nanotechnology”), in which  
5 matter is manipulated at the atomic level (i.e., atom-by-  
6 atom or molecule-by-molecule) in order to build materials,  
7 machines, and devices with novel properties or functions,  
8 are leading to unprecedented scientific and technological  
9 opportunities that will benefit society by changing the way  
10 many things are designed and made.

11 (2) Long-term nanoscale research and development  
12 leading to potential breakthroughs in areas such as mate-  
13 rials and manufacturing, electronics, medicine and  
14 healthcare, environment, energy, chemicals, biotechnology,  
15 agriculture, information technology, and national security  
16 could be as significant as the combined influences of  
17 microelectronics, biotechnology, and information tech-  
18 nology on the 20th century. Nanotechnology could lead to  
19 things such as—

20 (A) new generations of electronics where the en-  
21 tire collection of the Library of Congress is stored  
22 on devices the size of a sugar cube;

23 (B) manufacturing that requires less material,  
24 pollutes less, and is embedded with sophisticated  
25 sensors that will internally detect signs of weakness

1 and automatically respond by releasing chemicals  
2 that will prevent damage;

3 (C) prosthetic and medical implants whose sur-  
4 faces are molecularly designed to interact with the  
5 cells of the body;

6 (D) materials with an unprecedented combina-  
7 tion of strength, toughness, and lightness that will  
8 enable land, sea, air, and space vehicles to become  
9 lighter and more fuel efficient;

10 (E) selective membranes that can fish out spe-  
11 cific toxic or valuable particles from industrial waste  
12 or that can inexpensively desalinate sea water; and

13 (F) tiny robotic spacecraft that will cost less,  
14 consume very little power, adapt to unexpected envi-  
15 ronments, change its capabilities as needed, and be  
16 completely autonomous.

17 (3) Long-term, high-risk research is necessary to cre-  
18 ate breakthroughs in technology. Such research requires  
19 government funding since the benefits are too distant or  
20 uncertain for industry alone to support. Current Federal  
21 investments in nanotechnology research and development  
22 are not grounded in any specifically authorized statutory  
23 foundation. As a result, there is a risk that future funding  
24 for long-term, innovative research will be tentative and

1 subject to instability which could threaten to hinder future  
2 United States technological and economic growth.

3 (4) The Federal government can play an important  
4 role in the development of nanotechnology, as this science  
5 is still in its infancy, and it will take many years of sus-  
6 tained investment for this field to achieve maturity.

7 (5) Many foreign countries, companies and scientists  
8 believe that nanotechnology will be the leading technology  
9 of the 21st century and are investing heavily into its re-  
10 search. According to a study of international  
11 nanotechnology research efforts sponsored by the National  
12 Science and Technology Council, the United States is at  
13 risk of falling behind its international competitors, includ-  
14 ing Japan, South Korea, and Europe if it fails to sustain  
15 broad based funding in nanotechnology. The United  
16 States cannot afford to fall behind our competitors if we  
17 want to maintain our economic strength.

18 (6) Advances in nanotechnology stemming from Fed-  
19 eral investments in fundamental research and subsequent  
20 private sector development likely will create technologies  
21 that support the work and improve the efficiency of the  
22 Federal government, and contribute significantly to the ef-  
23 forts of the government's mission agencies.

24 (7) According to various estimates, including those  
25 of the National Science Foundation, the market for

1 nanotech products and services in the United States alone  
2 could reach over \$1 trillion later this century.

3 (8) Nanotechnology will evolve from modern advances  
4 in chemical, physical, biological, engineering, medical, and  
5 materials research, and will contribute to cross-discipli-  
6 nary training of the 21st century science and technology  
7 workforce.

8 (9) Mastering nanotechnology will require a unique  
9 skill set for scientists and engineers that combine chem-  
10 istry, physics, material science, and information science.  
11 Funding in these critical areas has been flat for many  
12 years and as a result fewer young people are electing to  
13 go into these areas in graduate schools throughout the  
14 United States. This will have to reverse if we hope to de-  
15 velop the next generation of skilled workers with multi-  
16 disciplinary perspectives necessary for the development of  
17 nanotechnology.

18 (10) Research on nanotechnology creates unprece-  
19 dented capabilities to alter ourselves and our environment  
20 and will give rise to a host of novel social, ethical, philo-  
21 sophical, and legal issues. To appropriately address these  
22 issues will require wide reflection and guidance that are  
23 responsive to the realities of the science, as well as addi-  
24 tional research to predict, understand, and alleviate antici-  
25 pated problems.

1           (11) Nanotechnology will provide structures to enable  
2 the revolutionary concept of quantum computing, which  
3 uses quantum mechanical properties to do calculation.  
4 Quantum computing permits a small number of atoms to  
5 potentially store and process enormous amounts of infor-  
6 mation. Just 300 interacting atoms in a quantum com-  
7 puter could store as much information as a classical elec-  
8 tronic computer that uses all the particles in the universe,  
9 and today's complex encryption algorithms, which would  
10 take today's best super computer 20 billion years, could  
11 be cracked in 30 minutes.

12           (12) The Executive Branch has previously established  
13 a National Nanotechnology Initiative to coordinate Fed-  
14 eral nanotechnology research and development programs.  
15 This initiative has contributed significantly to the develop-  
16 ment of nanotechnology. Authorizing legislation can serve  
17 to establish new technology goals and research directions,  
18 improve agency coordination and oversight mechanisms,  
19 help ensure optimal returns to investment, and simplify  
20 reporting, budgeting, and planning processes for the Exec-  
21 utive Branch and the Congress.

22           (13) The private sector technology innovations that  
23 grow from fundamental nanotechnology research are de-  
24 pendent on a haphazard, expensive, and generally ineffi-  
25 cient technology transition path. Strategies for accel-

1 erating the transition of fundamental knowledge and inno-  
2 vations in commercial products or to support mission  
3 agencies should be explored, developed, and when appro-  
4 priate, executed.

5 (14) Existing data on the societal, ethical, edu-  
6 cational, legal, and workforce implications and issues re-  
7 lated to nanotechnology are lacking. To help decision-mak-  
8 ers and affected parties better anticipate issues likely to  
9 arise with the onset and maturation of nanotechnology,  
10 research and studies on these issues must be conducted  
11 and disseminated.

12 **SEC. 3. PURPOSE.**

13 It is the purpose of this Act to authorize a coordi-  
14 nated inter-agency program that will support long-term  
15 nanoscale research and development leading to potential  
16 breakthroughs in areas such as materials and manufac-  
17 turing, nanoelectronics, medicine and healthcare, environ-  
18 ment, energy, chemicals, biotechnology, agriculture, infor-  
19 mation technology, and national and homeland security.

20 **SEC. 4. NATIONAL NANOTECHNOLOGY RESEARCH PRO-**  
21 **GRAM.**

22 (a) NATIONAL NANOTECHNOLOGY RESEARCH PRO-  
23 GRAM.—The President shall establish a National  
24 Nanotechnology Research Program. Through appropriate

1 agencies, councils, and the National Coordination Office,  
2 the program shall—

3 (1) establish the goals, priorities, grand chal-  
4 lenges, and metrics for evaluation for Federal  
5 nanotechnology research, development, and other ac-  
6 tivities;

7 (2) invest in Federal research and development  
8 programs in nanotechnology and related sciences to  
9 achieve those goals; and

10 (3) provide for interagency coordination of Fed-  
11 eral nanotechnology research, development, and  
12 other activities undertaken pursuant to the program.

13 (b) GOALS OF THE NATIONAL NANOTECHNOLOGY  
14 RESEARCH PROGRAM.—The goals of the program are as  
15 follows:

16 (1) The coordination of long-term fundamental  
17 nanoscience and engineering research to build a fun-  
18 damental understanding of matter enabling control  
19 and manipulation at the nanoscale.

20 (2) The assurance of continued United States  
21 global leadership in nanotechnology to meet national  
22 goals and to support national economic, health, na-  
23 tional security, educational, and scientific interests.

24 (3) The advancement of United States produc-  
25 tivity and industrial competitiveness through stable,

1 consistent, and coordinated investments in long-term  
2 scientific and engineering research in  
3 nanotechnology.

4 (4) The development of a network of shared  
5 academic facilities and technology centers that will  
6 play a critical role in accomplishing the other goals  
7 of the program, foster partnerships, and develop and  
8 utilize next generation scientific tools.

9 (5) The development of enabling infrastructural  
10 technologies that United States industry can use to  
11 commercialize new discoveries and innovations in  
12 nanoscience.

13 (6) The acceleration of the deployment and  
14 transition of advanced and experimental  
15 nanotechnology and concepts into the private sector.

16 (7) The establishment of a program designed to  
17 provide effective education and training for the next  
18 generation of researchers and professionals skilled in  
19 the multidisciplinary perspectives necessary for  
20 nanotechnology.

21 (8) To ensure that philosophical, ethical, and  
22 other societal concerns will be considered alongside  
23 the development of nanotechnology.

24 (c) RESEARCH AND DEVELOPMENT AREAS.—  
25 Through its participating agencies, the Nanotechnology

1 Research and Development Program shall develop, fund,  
2 and manage Federal research programs in the following  
3 areas:

4 (1) LONG-TERM FUNDAMENTAL RESEARCH.—

5 The program shall undertake long-term basic  
6 nanoscience and engineering research that focuses  
7 on fundamental understanding and synthesis of  
8 nanometer-size building blocks with potential for  
9 breakthroughs in areas such as materials and manu-  
10 facturing, nanoelectronics, medicine and healthcare,  
11 environment, energy, chemical and pharmaceuticals  
12 industries, biotechnology and agriculture, computa-  
13 tion and information technology, and national secu-  
14 rity. Funds made available from the appropriate  
15 agencies under this paragraph shall be used—

16 (A) to provide awards of less than  
17 \$1,000,000 each to single investigators and  
18 small groups to provide sustained support to in-  
19 dividual investigators and small groups con-  
20 ducting fundamental, innovative research; and

21 (B) to fund fundamental research and the  
22 development of university-industry-laboratory  
23 and interagency partnerships.

24 (2) GRAND CHALLENGES.—The program shall  
25 support grand challenges that are essential for the

1 advancement of the field and interdisciplinary re-  
2 search and education teams, including multidisci-  
3 plinary nanotechnology research centers, that work  
4 on major long-term objectives. This funding area will  
5 fund, through participating agencies, interdiscipli-  
6 nary research and education teams that aim to  
7 achieve major, long-term objectives, such as the fol-  
8 lowing:

9 (A) Nanomaterials by design which are  
10 stronger, lighter, harder, self-repairing, and  
11 safer.

12 (B) Nanoelectronics, optoelectronics, and  
13 magnetics.

14 (C) Healthcare applications.

15 (D) Nanoscale processes and environment.

16 (E) Energy and energy conservation.

17 (F) Microspacecraft.

18 (G) Bio-nanodevices for detection and miti-  
19 gation of biotreats to humans.

20 (H) Economical, efficient, and safe trans-  
21 portation.

22 (I) National security.

23 (J) Other appropriate challenges.

24 (3) INTERDISCIPLINARY NANOTECHNOLOGY RE-  
25 SEARCH CENTERS.—The appropriate agencies shall

1 fund 10 new centers in the range of \$3,000,000 to  
2 \$5,000,000 per year each for 5 years. A grant under  
3 this paragraph to a center may be renewed for 1 5-  
4 year term on the basis of that center's performance,  
5 determined after a review. The program, through its  
6 participating agencies, shall encourage research net-  
7 working among centers and researchers and require  
8 access to facilities to both academia and industry.  
9 The centers shall assist in reaching other initiative  
10 priorities, including fundamental research, grand  
11 challenges, education, development and utilization of  
12 specific research tools, and promoting partnerships  
13 with industry. To the greatest extent possible, agen-  
14 cies participating in the program shall establish geo-  
15 graphically diverse centers including at least one  
16 center in a State participating in the National  
17 Science Foundation's (NSF) Experimental Program,  
18 to Stimulate Competitive Research (EPSCoR), es-  
19 tablished under section 113 of the NSF Authoriza-  
20 tion Act of 1988 (42 U.S.C. 1862(g)).

21 (4) RESEARCH INFRASTRUCTURE.—The pro-  
22 gram, through its participating agencies, shall en-  
23 sure adequate research infrastructure and equipment  
24 for rapid progress on program goals, including the  
25 employment of underutilized manufacturing facilities

1 in areas of high unemployment as production engi-  
2 neering and research testbeds for micron-scale tech-  
3 nologies. Major research equipment and instrumen-  
4 tation shall be an eligible funding purpose under the  
5 program.

6 (5) SOCIETAL, ETHICAL, EDUCATIONAL, LEGAL,  
7 AND WORKFORCE ISSUES RELATED TO  
8 NANOTECHNOLOGY.—The Director of the National  
9 Science Foundation shall establish a new Center for  
10 Ethical, Societal, Educational, Legal, and Workforce  
11 Issues Related to Nanotechnology at \$5,000,000 per  
12 year to encourage, conduct, coordinate, commission,  
13 collect, and disseminate research on the societal, eth-  
14 ical, educational, legal, and workforce issues related  
15 to nanotechnology. The Center shall also conduct  
16 studies and provide input and assistance to the Di-  
17 rector of the National Science Foundation in com-  
18 pleting the annual report required under paragraph  
19 7(b)(3) of this Act.

20 (6) TRANSITION OF TECHNOLOGY.—The pro-  
21 gram, through its participating agencies, shall en-  
22 sure cooperation and collaboration with United  
23 States industry in all relevant research efforts and  
24 develop mechanisms to assure prompt technology  
25 transition.

1 **SEC. 5. PROGRAM COORDINATION AND MANAGEMENT.**

2 (a) IN GENERAL.—The National Science and Tech-  
3 nology Council shall oversee the planning, management,  
4 and coordination of the Federal nanotechnology research  
5 and development program. The Council, itself or through  
6 an appropriate subgroup it designates or establishes,  
7 shall—

8 (1) establish a set of broad applications of  
9 nanotechnology research and development, or grand  
10 challenges, to be met by the results and activities of  
11 the program, based on national needs;

12 (2) submit to the Congress through the Senate  
13 Committee on Commerce, Science, and Transpor-  
14 tation, and the House of Representatives Committee  
15 on Science, an annual report, along with the Presi-  
16 dent's annual budget request, describing the imple-  
17 mentation of the program under section 4;

18 (3) provide for interagency coordination of the  
19 program, including with the Department of Defense;

20 (4) coordinate the budget requests of each of  
21 the agencies involved in the program with the Office  
22 of Management and Budget to ensure that a bal-  
23 anced research portfolio is maintained in order to  
24 ensure the appropriate level of research effort;

25 (5) provide guidance each year to the partici-  
26 pating departments and agencies concerning the

1 preparation of appropriations requests for activities  
2 related to the program;

3 (6) consult with academic, industry, State and  
4 local government, and other appropriate groups con-  
5 ducting research on and using nanotechnology;

6 (7) establish an Information Services and Ap-  
7 plications Council to promote access to and early ap-  
8 plication of the technologies, innovations, and exper-  
9 tise derived from nanotechnology research and devel-  
10 opment program activities to agency missions and  
11 systems across the Federal government, and to  
12 United States industry;

13 (8) in cooperation with the Advisory Panel es-  
14 tablished under subsection (b), develop and apply  
15 measurements using appropriate metrics for evalu-  
16 ating program performance and progress toward  
17 goals; and

18 (9) identify research areas which are not being  
19 adequately addressed by the agencies' current re-  
20 search programs.

21 (b) PRESIDENT'S NANOTECHNOLOGY ADVISORY  
22 PANEL.—

23 (1) ESTABLISHMENT.—The President shall es-  
24 tablish a National Nanotechnology Advisory Panel.

1           (2) SELECTION PROCEDURES.—The President  
2 shall establish procedures for the selection of individ-  
3 uals not employed by the Federal government who  
4 are qualified in the science of nanotechnology and  
5 other appropriate fields and may, pursuant to such  
6 procedures, select up to 20 individuals, one of whom  
7 shall be designated Chairman, to serve on the Advi-  
8 sory Panel. Selection of individuals for the Advisory  
9 Panel shall be based solely on established records of  
10 distinguished fundamental and applied scientific  
11 service, and the panel shall contain a reasonable  
12 cross-section of views and expertise, including those  
13 regarding the societal, ethical, educational, legal,  
14 and workforce issues related to nanotechnology. In  
15 selecting individuals to serve on the Advisory Panel,  
16 the President shall seek and give due consideration  
17 to recommendations from the Congress, industry,  
18 the scientific community (including the National  
19 Academy of Sciences), scientific professional soci-  
20 eties, academia, the defense community, the edu-  
21 cation community, State and local governments, and  
22 other appropriate organizations.

23           (3) MEETINGS.—The Advisory Panel shall meet  
24 no less than twice annually, at such times and places  
25 as may be designated by the Chairman in consulta-

1 tion with the National Nanotechnology Coordination  
2 Office established under subsection 5(c) of this Act.

3 (4) DUTIES.—The Advisory Panel shall advise  
4 the President and the National Science and Tech-  
5 nology Council, and inform the Congress, on matters  
6 relating to the National Nanotechnology Program,  
7 including goals, roles, and objectives within the pro-  
8 gram, its capabilities and research needs, guidance  
9 on achieving major objectives, and establishing and  
10 measuring performance goals using appropriate  
11 metrics. The Advisory Panel shall issue an annual  
12 report, containing the information required by sub-  
13 section (d) of this section, to the President, the  
14 Council, the heads of each agency involved in the  
15 program, the Senate Committee on Commerce,  
16 Science, and Transportation, and the House of Rep-  
17 resentatives Committee on Science, on or before Sep-  
18 tember 30 of each year.

19 (c) NATIONAL NANOTECHNOLOGY COORDINATION  
20 OFFICE.—The President shall establish a National  
21 Nanotechnology Coordination Office, with full-time staff,  
22 to provide day-to-day technical and administrative support  
23 to the Council and the Advisory Panel, and to be the point  
24 of contact on Federal nanotechnology activities for govern-  
25 ment organizations, academia, industry, professional soci-

1 eties, and others to exchange technical and programmatic  
2 information. The Office shall assure full coordination of  
3 research efforts between agencies, scientific disciplines,  
4 and United States industry.

5 (d) PROGRAM PLANS AND REPORTS.—

6 (1) ANNUAL EVALUATION OF NANOTECHNOL-  
7 OGY RESEARCH DEVELOPMENT PROGRAM.—The re-  
8 port by the Advisory Panel, required pursuant to  
9 subsection (b)(4), shall include—

10 (A) a review of the program’s technical  
11 success in achieving the stated goals and grand  
12 challenges according to the metrics established  
13 by the program and Advisory Panel;

14 (B) a review of the program’s management  
15 and coordination;

16 (C) a review of the funding levels by each  
17 agency for the program’s activities and their  
18 ability to achieve the program’s stated goals  
19 and grand challenges;

20 (D) a review of the balance in the pro-  
21 gram’s portfolio and components across agen-  
22 cies and disciplines;

23 (E) an assessment of the degree of partici-  
24 pation in the program by minority serving insti-

1           tutions and institutions located in States par-  
2           ticipating in NSF's EPSCoR program;

3           (F) a review of policy issues resulting from  
4           advancements in nanotechnology and its effects  
5           on the scientific enterprise, commerce, work-  
6           force, competitiveness, national security, medi-  
7           cine, and government operations;

8           (G) recommendations for new program  
9           goals and grand challenges;

10          (H) recommendations for new research  
11          areas, partnerships, coordination and manage-  
12          ment mechanisms, or programs to be estab-  
13          lished to achieve the program's stated goals and  
14          grand challenges;

15          (I) recommendations for new investments  
16          by each participating agency in each program  
17          funding area for the 5-year period following the  
18          delivery of the report;

19          (J) reviews and recommendations regard-  
20          ing other issues deemed pertinent or specified  
21          by the panel; and

22          (K) a technology transition study which in-  
23          cludes an evaluation of the Federal  
24          nanotechnology research and development pro-  
25          gram's success in transitioning its research,

1 technologies, and concepts into commercial and  
2 military products, including—

3 (i) examples of successful transition of  
4 research, technologies, and concepts from  
5 the Federal nanotechnology research and  
6 development program into commercial and  
7 military products;

8 (ii) best practices of universities, gov-  
9 ernment, and industry in promoting effi-  
10 cient and rapid technology transition in the  
11 nanotechnology sector;

12 (iii) barriers to efficient technology  
13 transition in the nanotechnology sector, in-  
14 cluding, but not limited to, standards, pace  
15 of technological change, qualification and  
16 testing of research products, intellectual  
17 property issues, and Federal funding; and

18 (iv) recommendations for government  
19 sponsored activities to promote rapid tech-  
20 nology transition in the nanotechnology  
21 sector.

22 (2) OFFICE OF MANAGEMENT AND BUDGET RE-  
23 PORT.—

24 (A) BUDGET REQUEST REPORT.—Each  
25 Federal agency and department participating in

1 the program shall, as part of its annual request  
2 for appropriations, submit a report to the Office  
3 of Management and Budget which—

4 (i) identifies each element of its  
5 nanotechnology research and development  
6 activities that contributes directly to the  
7 program or benefits from the program;

8 (ii) states the portion of its request  
9 for appropriations that is allocated to each  
10 such element; and

11 (iii) states the portion of its request  
12 for appropriations that is allocated to each  
13 program funding area.

14 (B) OMB REVIEW AND ALLOCATION  
15 STATEMENT.—The Office of Management and  
16 Budget shall review each report in light of the  
17 goals, priorities, grand challenges, and agency  
18 and departmental responsibilities set forth in  
19 the annual report of the Council under para-  
20 graph (3), and shall include in the President's  
21 annual budget estimate, a statement delineating  
22 the amount and portion of each appropriate  
23 agency's or department's annual budget esti-  
24 mate relating to its activities undertaken pursu-  
25 ant to the program.

1           (3) ANNUAL NSTC REPORT TO CONGRESS ON  
2 THE NANOTECHNOLOGY RESEARCH DEVELOPMENT  
3 PROGRAM.—The National Science and Technology  
4 Council shall submit an annual report to the Con-  
5 gress that—

6           (A) includes a detailed description of the  
7 goals, grand challenges, and program funding  
8 areas established by the President for the pro-  
9 gram;

10           (B) sets forth the relevant programs and  
11 activities, for the fiscal year with respect to  
12 which the budget submission applies, of each  
13 Federal agency and department, participating  
14 in the program, as well as such other agencies  
15 and departments as the President or the Direc-  
16 tor considers appropriate;

17           (C) describes the levels of Federal funding  
18 for the fiscal year during which such report is  
19 submitted, and the levels proposed for the fiscal  
20 year with respect to which the budget submis-  
21 sion applies, for each of the program funding  
22 areas of the program;

23           (D) describes the levels of Federal funding  
24 for each agency and department participating  
25 in the program and each program funding area

1 for the fiscal year during which such report is  
2 submitted, and the levels proposed for the fiscal  
3 year with respect to which the budget submis-  
4 sion applies, and compare these levels to the  
5 most recent recommendations of the Advisory  
6 Panel and the external review of the program;

7 (E) describes coordination and partnership  
8 activities with State, local, international, and  
9 private sector efforts in nanotechnology re-  
10 search and development, and how they support  
11 the goals of the program;

12 (F) describes mechanisms and efforts used  
13 by the program to assist in the transition of in-  
14 novative concepts and technologies from Feder-  
15 ally funded programs into the commercial sec-  
16 tor, and successes in these transition activities;

17 (G) describes coordination between the  
18 military and civilian portions, as well as the life  
19 science and non-life science portions, of the pro-  
20 gram in technology development, supporting the  
21 goals of the program, and supporting the mis-  
22 sion needs of the departments and agencies in-  
23 volved;

24 (H) analyzes the progress made toward  
25 achieving the goals, priorities, and grand chal-

1           lenges designated for the program according to  
2           the metrics established by the program and the  
3           Advisory Panel; and

4           (I) recommends new mechanisms of coordi-  
5           nation, program funding areas, partnerships, or  
6           activities necessary to achieve the goals, prior-  
7           ities, and grand challenges established for the  
8           program.

9           (4)   TRIENNIAL   EXTERNAL   REVIEW   OF  
10          NANOTECHNOLOGY RESEARCH AND DEVELOPMENT  
11          PROGRAM.—

12          (A)   IN GENERAL.—Not later than 6  
13          months after the date of enactment of this Act,  
14          the Director of the National Science Founda-  
15          tion shall enter into an arrangement with the  
16          National Research Council of the National  
17          Academy of Sciences to conduct a triennial  
18          evaluation of the Federal nanotechnology re-  
19          search and development program, including—

20               (i) a review of the technical success of  
21               the program in achieving the stated goals  
22               and grand challenges under the metrics es-  
23               tablished by the program and the  
24               nanotechnology Advisory Panel, and under  
25               other appropriate measurements;

1 (ii) a review of the program’s manage-  
2 ment and coordination across agencies and  
3 disciplines;

4 (iii) a review of the funding levels by  
5 each agency for the program’s activities  
6 and their ability with such funding to  
7 achieve the program’s stated goals and  
8 grand challenges;

9 (iv) recommendations for new or re-  
10 vised program goals and grand challenges;

11 (v) recommendations for new research  
12 areas, partnerships, coordination and man-  
13 agement mechanisms, or programs to be  
14 established to achieve the program’s stated  
15 goals and grand challenges;

16 (vi) recommendations for investment  
17 levels in light of goals by each partici-  
18 pating agency in each program funding  
19 area for the 5-year period following the de-  
20 livery of the report;

21 (vii) recommendations on policy, pro-  
22 gram, and budget changes with respect to  
23 nanotechnology research and development  
24 activities;

1 (viii) recommendations for improved  
2 metrics to evaluate the success of the pro-  
3 gram in accomplishing its stated goals; and

4 (ix) a review of the performance of  
5 the Information Services and Applications  
6 Council and its efforts to promote access  
7 to and early application of the tech-  
8 nologies, innovations, and expertise derived  
9 from program activities to agency missions  
10 and systems across the Federal govern-  
11 ment and to United States industry.

12 (B) EVALUATION TO BE TRANSMITTED TO  
13 CONGRESS.—The Director of the National  
14 Science Foundation shall transmit the results of  
15 any evaluation for which it made arrangements  
16 under subparagraph (A) to the Senate Com-  
17 mittee on Commerce, Science, and Transpor-  
18 tation and the House of Representatives Com-  
19 mittee on Science upon receipt. The first such  
20 evaluation shall be transmitted no later than 12  
21 months after the date of the enactment of this  
22 Act, with subsequent evaluations transmitted to  
23 the Committees every 3 years thereafter.

24 **SEC. 6. AUTHORIZATION OF APPROPRIATIONS.**

25 (a) NATIONAL SCIENCE FOUNDATION.—

1           (1) GENERAL AUTHORIZATION.—There are au-  
2           thorized to be appropriated to the Director of the  
3           National Science Foundation to carry out the Direc-  
4           tor’s responsibilities under this Act—

5                   (A) \$221,000,000 for fiscal year 2003; and

6                   (B) \$254,150,000 for fiscal year 2004.

7           (2) SPECIFIC ALLOCATIONS.—

8                   (A) INTERDISCIPLINARY NANOTECHNOL-  
9                   OGY RESEARCH CENTERS.—Of the amounts de-  
10                  scribed in paragraph (1), \$40,000,000 for fiscal  
11                  year 2003, \$50,000,000 for fiscal year 2004,  
12                  shall be available for grants of up to  
13                  \$5,000,000 each for multidisciplinary  
14                  nanotechnology research centers.

15                  (B) CENTER FOR SOCIETAL, ETHICAL,  
16                  EDUCATIONAL, LEGAL, AND WORKFORCE  
17                  ISSUES RELATED TO NANOTECHNOLOGY.—Of  
18                  the sums authorized for the National Science  
19                  Foundation each fiscal year, \$5,000,000 shall  
20                  be used to establish a university-based Center  
21                  for Societal, Ethical, Educational, Legal, and  
22                  Workforce Issues Related to Nanotechnology.

23                  (C) NATIONAL NANOTECHNOLOGY COORDI-  
24                  NATION OFFICE.—Of the sums authorized for  
25                  the National Science Foundation each fiscal

1 year, \$5,000,000 shall be used for the activities  
2 of the Nanotechnology Coordination Office.

3 (D) GAP FUNDING THROUGH THE SCIENCE  
4 AND TECHNOLOGY POLICY INSTITUTE.—Of the  
5 sums authorized for the National Science Foun-  
6 dation each fiscal year, \$5 million shall be for  
7 the Science and Technology Policy Institute, in  
8 consultation with the Office of Science and  
9 Technology Policy, for use in competitive grants  
10 to address research areas identified by the  
11 council under section 5(a)(9) of this Act. Such  
12 grants may be made to government or non-gov-  
13 ernment awardees.

14 (b) DEPARTMENT OF ENERGY.—There are author-  
15 ized to be appropriated to the Secretary of Energy to carry  
16 out the Secretary's responsibilities under this Act—

17 (1) \$139,300,000 for fiscal year 2003; and

18 (2) \$160,195,000 for fiscal year 2004.

19 (c) NATIONAL AERONAUTICS AND SPACE ADMINIS-  
20 TRATION.—There are authorized to be appropriated to the  
21 Administrator of the National Aeronautics and Space Ad-  
22 ministration to carry out the Administrator's responsibil-  
23 ities under this Act—

24 (1) \$22,000,000 for fiscal year 2003; and

25 (2) \$25,300,000 for fiscal year 2004.

1 (d) NATIONAL INSTITUTES OF HEALTH.—There are  
2 authorized to be appropriated to the Director of the Na-  
3 tional Institutes to carry out the Director’s responsibilities  
4 under this Act—

5 (1) \$43,200,000 for fiscal year 2003; and

6 (2) \$49,680,000 for fiscal year 2004.

7 (e) NATIONAL INSTITUTE OF STANDARDS AND  
8 TECHNOLOGY.—There are authorized to be appropriated  
9 to the Director of the National Institute of Standards and  
10 Technology to carry out the Director’s responsibilities  
11 under this Act—

12 (1) \$44,000,000 for fiscal year 2003; and

13 (2) \$50,600,000 for fiscal year 2004;

14 (f) ENVIRONMENTAL PROTECTION AGENCY.—There  
15 are authorized to be appropriated to the Administrator of  
16 the Environmental Protection Agency to carry out the Ad-  
17 ministrator’s responsibilities under this Act—

18 (1) \$5,000,000 for fiscal year 2003; and

19 (2) \$5,750,000 for fiscal year 2004.

20 (g) DEPARTMENT OF JUSTICE.—There are author-  
21 ized to be appropriated to the Director of the National  
22 Institute of Justice to carry out the Director’s responsibil-  
23 ities under this Act—

24 (1) \$1,400,000 for fiscal year 2003; and

25 (2) \$1,610,000 for fiscal year 2004.

1 **SEC. 7. ADDITIONAL REPORTS, STUDIES, AND PLANS.**

2 (a) INTERNATIONAL BENCHMARKING STUDIES.—

3 (1) UNITED STATES STANDING TO BE MON-  
4 ITORED.—In order to maintain world leadership in  
5 nanotechnology, the program established under sec-  
6 tion 4(a) shall monitor the United States' standing  
7 in the key research fields that support technological  
8 innovation.

9 (2) BIENNIAL NSTC STUDY OF RELATIVE  
10 UNITED STATES POSITION.—Not later than 3  
11 months after the date of enactment of this Act, the  
12 President, through the Council, shall enter into an  
13 arrangement with the National Research Council of  
14 the National Academy of Sciences to conduct a bien-  
15 nial study of the relative position of United States  
16 compared to other nations with respect to  
17 nanotechnology research and development.

18 (3) ISSUES TO BE ADDRESSED.—The study re-  
19 quired by paragraph (2) shall address, among other  
20 issues—

21 (A) the current and likely future relative  
22 position of United States private sector, aca-  
23 demic, and government research in  
24 nanotechnology relative to other nations;

1 (B) niche nanotechnology research areas  
2 where the United States is trailing other na-  
3 tions;

4 (C) critical research areas where the  
5 United States should be the world leader to  
6 best achieve the goals of the Federal  
7 nanotechnology research and development pro-  
8 gram;

9 (D) key factors influencing relative United  
10 States performance in this field; and

11 (E) institutional, funding, and human-re-  
12 source factors that are critical to maintaining  
13 leadership status in this field.

14 (4) ACTION PLAN.—Not less than 6 months  
15 after receipt of each study, the Council shall develop  
16 a plan for addressing the issues raised in the study.  
17 The plan shall include—

18 (A) investment strategies for addressing  
19 the issues raised in the report;

20 (B) strategies for promoting international  
21 research cooperation to leverage international  
22 niches of excellence identified by the report; and

23 (C) institutional and human-resource  
24 changes to be made to achieve or maintain lead-  
25 ership status in this field.

1           (5) TRANSMITTAL TO CONGRESS.—The Council  
2 shall submit the study required by paragraph (2)  
3 and the plan required by paragraph (4) to the Sen-  
4 ate Committee on Commerce, Science, and Trans-  
5 portation and the House of Representatives Com-  
6 mittee on Science, not later than 18 months after  
7 the date of enactment of this Act and every 2 years  
8 thereafter.

9           (b) SOCIETAL, ETHICAL, EDUCATION, LEGAL, AND  
10 WORKFORCE ISSUES RELATED TO NANOTECHNOLOGY.—

11           (1) STUDIES.—The Director of the National  
12 Science Foundation shall encourage, conduct, coordi-  
13 nate, commission, collect, and disseminate studies on  
14 the societal, ethical, educational, and workforce im-  
15 plications of nanotechnology through the Center for  
16 Societal, Ethical, Educational, and Workforce Issues  
17 established under section 4(c)(5). The studies shall  
18 identify anticipated issues and problems, as well as  
19 provide recommendations for preventing or address-  
20 ing such issues and problems.

21           (2) DATA COLLECTION.—The Director of the  
22 National Science Foundation shall collect data on  
23 the size of the anticipated nanotechnology workforce  
24 need by detailed occupation, industry, and firm char-  
25 acteristics, and assess the adequacy of the trained

1 talent pool in the United States to fill such work-  
2 force needs.

3 (3) ANNUAL REPORT.—The Director of the Na-  
4 tional Science Foundation shall compile the studies  
5 required by paragraph (2) and, with the assistance  
6 of the Center for Ethical, Societal, Educational,  
7 Legal, and Workforce Issues Related to  
8 Nanotechnology established by paragraph 4(c)(5) if  
9 this Act, shall complete a report that includes a de-  
10 scription of the Center’s activities, which shall be  
11 submitted to the President, the Council, the Senate  
12 Committee on Commerce, Science, and Transpor-  
13 tation, and the House of Representatives Committee  
14 on Science not later than 18 months after the date  
15 of enactment of this Act.

16 **SEC. 8. DEFINITIONS.**

17 In this Act:

18 (1) ADVISORY PANEL.—The term “Advisory  
19 Panel” means the President’s National  
20 Nanotechnology Panel.

21 (2) FUNDAMENTAL RESEARCH.—The term  
22 “fundamental research” means research that builds  
23 a fundamental understanding and leads to discov-  
24 eries of the phenomena, processes, and tools nec-

1        essary to control and manipulate matter at the  
2        nanoscale.

3           (3) GRAND CHALLENGE.—The term “grand  
4        challenge” means a fundamental problem in science  
5        or engineering, with broad economic and scientific  
6        impact, whose solution will require the application of  
7        nanotechnology.

8           (4) INTERDISCIPLINARY NANOTECHNOLOGY RE-  
9        SEARCH CENTER.—The term “interdisciplinary  
10       nanotechnology research center” means a group of 6  
11       or more researchers collaborating across scientific  
12       and engineering disciplines on large-scale long-term  
13       research projects that will significantly advance the  
14       science supporting the development of  
15       nanotechnology or the use of nanotechnology in ad-  
16       dressing scientific issues of national importance,  
17       consistent with the goals set forth in section 4(b).

18           (5) NANOTECHNOLOGY.—The term  
19       “nanotechnology” means the ability to work at the  
20       molecular level, atom-by-atom, to create large struc-  
21       tures with fundamentally new molecular organiza-  
22       tion.

23           (6) PROGRAM.—The term “program” means  
24       the national nanotechnology research program estab-  
25       lished under section 4.

1           (7) RESEARCH INFRASTRUCTURE.—The term  
2           “research infrastructure” means the measurement  
3           science, instrumentation, modeling and simulation,  
4           and user facilities needed to develop a flexible and  
5           enabling infrastructure so that United States indus-  
6           try can rapidly commercialize new discoveries in  
7           nanotechnology.

**Calendar No. 772**

107<sup>TH</sup> CONGRESS  
2<sup>D</sup> SESSION

**S. 2945**

**[Report No. 107-350]**

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**A BILL**

To authorize appropriations for nanoscience,  
nanoengineering, and nanotechnology research,  
and for other purposes.

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NOVEMBER 20, 2002

Reported without amendment